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## Brief Report

# Regret and adaptive decision making in young children



Eimear O'Connor<sup>a,\*</sup>, Teresa McCormack<sup>a</sup>, Sarah R. Beck<sup>b</sup>, Aidan Feeney<sup>a</sup>

<sup>a</sup> School of Psychology, Queen's University Belfast, Belfast BT7 1NN, UK

<sup>b</sup> School of Psychology, University of Birmingham, Birmingham B15 2TT, UK

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## ABSTRACT

In line with the claim that regret plays a role in decision making, O'Connor, McCormack, and Feeney (*Child Development*, 85 (2014) 1995–2010) found that children who reported feeling sadder on discovering they had made a non-optimal choice were more likely to make a different choice the next time around. We examined two issues of interpretation regarding this finding: whether the emotion measured was indeed regret and whether it was the experience of this emotion, rather than the ability to anticipate it, that affected decision making. To address the first issue, we varied the degree to which children aged 6 or 7 years were responsible for an outcome, assuming that responsibility is a necessary condition for regret. The second issue was addressed by examining whether children could accurately anticipate that they would feel worse on discovering they had made a non-optimal choice. Children were more likely to feel sad if they were responsible for the outcome; however, even if they were not responsible, children were more likely than chance to report feeling sadder. Moreover, across all conditions, feeling sadder was associated with making a better subsequent choice. In a separate task, we demonstrated that children of this age cannot accurately anticipate feeling sadder on discovering that they had not made the best choice. These findings suggest that although children may feel regret following a non-optimal choice, even if they were not responsible for an outcome, they may experience another negative emotion such as frustration. Experiencing either of these emotions seems to be sufficient to support better decision making.

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\* Corresponding author. Fax: +44 28 90 975486.

E-mail address: [e.oconnor@qub.ac.uk](mailto:e.oconnor@qub.ac.uk) (E. O'Connor).

## Introduction

Regret is an aversive emotion that we experience when we believe that we would have obtained a better outcome had we chosen differently (Epstude & Roese, 2008). Although regret is aversive, it appears to be a functional emotion in the sense that it assists in decision making (Epstude & Roese, 2008; Zeelenberg & Pieters, 2007). Experiencing regret following a poor choice is likely to lead us to change our behavior (Ku, 2008). Moreover, when deciding how to act, we often try to anticipate and thus minimize the regret that might arise from our decisions (Zeelenberg & Pieters, 2007).

Recently, the developmental psychology of regret has received considerable attention (Burns, Riggs, & Beck, 2012; O'Connor, McCormack, & Feeney, 2012, 2014; Rafetseder & Perner, 2012; van Duijvenvoorde, Huizenga, & Jansen, 2014; Weisberg & Beck, 2010; Weisberg & Beck, 2012). In a typical study, O'Connor and colleagues (2012) presented children with a choice between two boxes. In regret trials the prize in the chosen box was always less attractive than that in the non-chosen box, whereas in the baseline trial the prizes were equally attractive. Children selected a box for a prize and then rated on a 5-point scale how they felt about choosing their prize. The alternative prize was revealed, and children indicated, using a three-pronged arrow, whether they now felt happier, sadder, or the same about choosing their prize. By 6 or 7 years of age, children indicated feeling sadder on regret trials but not on the baseline trial, which was interpreted as evidence that children experience regret from this age.

If regret is a functional emotion, then its emergence should have implications for children's decision making. O'Connor and colleagues (2014) gave children the box choice task (Day 1) and then returned the next day (Day 2) to present children with the same choices. They hypothesized that if the experience of regret affects decision making, children who experience regret on Day 1 should be more likely to make a different choice in regret trials on Day 2 than those who do not experience regret. To control for a general preference to switch choices, adaptive decision makers were defined as those who were willing to pay a small cost to switch in regret trials on Day 2 but were not willing to pay this cost to switch in baseline trials. O'Connor and colleagues found that participants who experienced regret on Day 1 were significantly more likely to switch on Day 2, and this result held when controlling for age and verbal ability. O'Connor and colleagues established that this association was not due to children who experienced regret having better memory for the contents of the boxes by assessing memory in a separate study. They argued that the experience of regret leads to better decision making in this task, possibly by increasing the likelihood that, when faced with the same choice again, children spontaneously bring to mind and evaluate choice options (see O'Connor et al., 2014, for discussion).

There are at least two issues of interpretation with these findings. The first is whether children's decisions on Day 2 in O'Connor and colleagues' (2014) study were really a result of experiencing regret on Day 1 rather than a consequence of some other negative emotion such as frustration (Rafetseder & Perner, 2012). Weisberg and Beck (2012) argued that if the emotion measured in this type of study is indeed regret, it should be affected by the level of responsibility one has regarding the outcome because, at least among psychologists, responsibility for an outcome is usually considered to be a necessary condition for regret (Zeelenberg, van Dijk, & Manstead, 2000). In a study of regret using a similar box choice task, Weisberg and Beck (2012) manipulated the extent to which children perceived themselves to be responsible for the choice; the outcome was determined by the child's choice or the roll of a die. In that study, 6- and 7-year-olds felt sadder when they had chosen the box compared with conditions involving a die, suggesting that the negative emotion that they reported was regret. However, unlike O'Connor and colleagues (2014), Weisberg and Beck (2012) did not examine the impact of children's negative emotions on decision making, and it remains possible that, rather than regret having a distinctive effect on children's choices, other negative emotions would show the same relation with decision making.

A further difficulty with interpreting an association between the reported experience of regret and adaptive decision making hinges on the important distinction between experienced and anticipated

regret (Zeelenberg & Pieters, 2007). O'Connor and colleagues (2014) argued that the experience of regret directly affected children's subsequent decisions. However, most theorizing on regret and decision making has focused on the effects of anticipating regret (predicting future regret and trying to avoid it) rather than its experience. Indeed, some theorists hold that the primary way in which emotion affects behavior is through simulation of emotional responses to outcomes that are in prospect (Baumeister, Vohs, DeWall, & Zhang, 2007). Perhaps the association between reported regret on Day 1 and decision making on Day 2 was mediated by anticipated regret in that those children who experienced regret on Day 1 were also likely to be those children who could anticipate regret. When faced with the same choice on Day 2, this ability to anticipate regret may have led to children switching choices to avoid future regret. If this is correct, it would suggest that simply experiencing regret might not have the functional role in children's decision making that O'Connor and colleagues (2014) ascribed to it. Rather, in line with theorizing about adult decision making, regret affects decision making primarily because in choosing a course of action we attempt to avoid it.

The distinction between experienced regret and anticipated regret is particularly pertinent in a developmental context because they have different developmental profiles. Using a paradigm first described by Guttentag and Ferrell (2008), McCormack and Feeney (2015) examined the age at which children are capable of anticipating regret. Children saw three boxes and were told that inside each box was a good prize, a medium prize, or nothing (in reality all three boxes contained a medium prize). One box was removed from the game, and then children chose between the remaining two boxes. On seeing that they had won the medium prize, children indicated how they felt on a 5-point scale. Next, they used a three-pronged arrow to predict whether they would feel the same, happier, or sadder if they discovered that the large prize was in the unchosen box. There was a developmental lag of at least 1 year between the experience and anticipation of regret; it was not until 8 years of age that children were able to accurately predict that they would feel sadder, whereas in a separate task using O'Connor and colleagues' (2012) original paradigm nearly all 6- and 7-year-olds experienced regret.

The current study was designed to address these two issues of interpretation with O'Connor and colleagues (2014) results: (a) whether the association they found between reported emotion and decision making is best described as one between regret (rather than some other negative emotion) and children's choices and (b) whether experienced emotion (rather than anticipated emotion) underlies this association. To address the first issue (a), we used Weisberg and Beck's (2012) manipulation of outcome responsibility to see whether the relation between emotion and adaptive decision making previously reported could confidently be attributed to regret. To address the second issue (b), we measured both experienced and anticipated regret to see which was the best predictor of adaptive decision making. Participants in the current study completed an experienced regret task on Day 1, completed the choice switching task on Day 2, and then completed an anticipated regret task.

## Method

### *Participants*

A total of 229 6- and 7-year-olds (122 girls and 107 boys,  $M_{\text{age}} = 81$  months, range = 72–95) were recruited from schools. One of these schools served a predominantly upper middle-class population, whereas the remaining six schools served middle- and working-class populations. The vast majority of participants were of Caucasian origin. Children were randomly assigned to one of three conditions: Self ( $n = 76$ ), Dice–Self ( $n = 78$ ), or Dice–Other ( $n = 75$ ). There was no significant difference between conditions in relation to age or gender of participants.

### *Apparatus*

The apparatus for the experienced regret task included the following: for the baseline trial, two different-colored boxes, each containing a smaller box with 1 plastic token inside; for the regret trial, two

different-colored boxes, each containing two smaller boxes, one with 1 token and the other with 10 tokens inside. A two-colored die was used in the Dice–Self and Dice–Other conditions. An additional three gold boxes were used for the anticipated regret task, with each gold box having a distinct image on the lid along with a high-valued prize (Lego set or friendship bracelet set), a medium-valued prize (coloring pencils, bouncy balls, or stretchy toy), and a low-valued prize (paper clip). A 5-point scale with pictures of faces ranging from very happy to very sad was used to elicit children's emotion ratings. Children indicated how they felt by placing a three-pronged arrow at the appropriate face. This arrow had one prong pointing upward, one pointing left, and one pointing right to enable children to report a subsequent change in feelings.

### *Procedure*

Children were tested individually over 2 consecutive days in their schools. On Day 1, children were invited to play a game where they could win tokens that they could swap for stickers. All children were first introduced to the 5-point scale and trained in its use (see O'Connor et al., 2012, for the full training procedure). The training involved two puppets receiving or losing gifts, and children used the three-pronged arrow to indicate whether the puppet felt happier (leftward prong), sadder (rightward prong), or the same (upward prong) over four different scenarios. The experimental trials did not commence until each child answered the four training questions correctly.

The baseline trial was always introduced first because previous findings suggest that this increases the likelihood of children experiencing regret in the regret trial (O'Connor et al., 2012; van Duijvenvoorde et al., 2014). The procedure for both trials was identical. Children in the Self condition were asked to select one of the two boxes, and the chosen box was then opened and the actual prize was revealed (1 token in both trials). Children indicated their emotional response on the 5-point scale. Next, the non-chosen box was opened, and the alternative prize (1 token in the baseline trial and 10 tokens in the regret trial) was revealed. Children used the three-pronged arrow to indicate whether they now felt happier, sadder, or the same after seeing the alternative prize. Children then watched as the tokens were returned to the appropriate boxes and their name was written on their chosen box. The experimenter explained that the game would be played again the following day, emphasizing that the same prizes would be in the same boxes. After children completed both trials, they swapped their tokens for two stickers. The Dice–Self and Dice–Other conditions were identical to the Self condition except that the roll of a colored die determined box selection. In the Dice–Self condition children rolled the die, whereas in the Dice–Other condition children observed the experimenter rolling the die.

Trials were presented in the same order on Day 2; children were shown their name on their previously selected box and were reminded that the same prizes were in the same boxes as before. On Day 2, all children chose the box from which they would like a prize. Before selecting a box in each trial, the experimenter gave children 1 new token and told them that it was theirs “for now” but explained that switching boxes cost 1 token and choosing the previously selected box was free (this was required to control for a general tendency to switch choices; see O'Connor et al., 2014). Children were asked whether they would like to pay 1 token to switch boxes or choose the same box for free. Children received 1 token in the baseline trial regardless of box choice. In the regret trial, children won 10 tokens if they switched boxes or 1 token if they did not.

Next, in the anticipated regret task, children were shown the three gold boxes along with the high-valued, medium-valued, and low-valued prizes. Children were asked which prize was the best and which was the worst. The experimenter explained that each of the boxes contained one of the prizes, whereas in reality each box contained a medium-valued prize. Children were asked to remove one box and then to choose between the remaining two boxes. Children rated how they felt about winning the medium-valued prize using the 5-point scale. The experimenter then said, “You won the [description of prize] from your box; that's your prize to keep.” Next, the experimenter pointed at the non-chosen box and said, “What if the best prize is in this box, the box you did not chose . . .,” and then pointed at the chosen box and said, “. . . then how would you feel about choosing your box?”

## Results

### *Experienced regret*

**Table 1** shows the number of participants who felt happier, sadder, or the same after seeing the alternative prize in each trial broken down by condition. Binomial tests compared responses with chance performance (33%); in each condition, in the baseline trial children were more likely than chance to report no change in happiness rating (all  $ps < .001$ ) and in the regret trial they were more likely than chance to report feeling sadder (all  $ps < .05$ ). Although there was no overall effect of condition on changes in happiness rating in either trial, there was an association between condition and whether or not children felt sadder in the regret trial only,<sup>1</sup> with children in the Self condition being more likely to say that they felt sadder than those in the Dice–Other condition ( $\chi^2 = 4.14$ ,  $df = 1$ ,  $p < .05$ ,  $\Phi_c = .18$ ). There was no significant difference between the Dice–Self condition and either of the other two conditions.

### *Choice switching*

Children who paid to switch boxes in the regret trial, but not in the baseline trial, were classified as adaptive switchers. In **Table 2**, we report switching behavior in each trial broken down by condition and by whether children felt sadder in the regret trial only (i.e., sadder in the regret trial and happier or the same in the baseline trial). There was no significant association between switching behavior and condition, with similar numbers adaptively switching in all groups. A significant association was found overall between whether children reported feeling sadder in the regret trial only on Day 1 and whether children were classified as adaptive switchers on Day 2 ( $\chi^2 = 14.59$ ,  $df = 1$ ,  $p < .001$ ,  $\Phi_c = .26$ ), and this association held for each condition separately (all  $\chi^2s > 5.44$ ,  $ps < .05$ ). Therefore, children who had reported feeling sadder in the regret trial only were more likely to switch adaptively when faced with the same choice again.

### *Anticipated regret*

Of the total sample, 18 children did not appropriately rank the prizes used in the anticipated regret task and were excluded from subsequent analysis. Of the remaining 211 children, 75 indicated that they would feel sadder if the better prize was in the non-chosen box, 101 that they would feel happier, and 35 that they would feel the same. The distribution of responses across the three categories differed significantly from chance (goodness-of-fit  $\chi^2 = 31.43$ ,  $df = 2$ ,  $p < .001$ ), with happier being the most common response. The tendency of children of this age to predict that they would feel happier under such circumstances was also reported across three experiments by [McCormack and Feeney \(2015\)](#), who interpreted this as evidence that children adopt a summative approach (see [McCloy & Strange, 2009](#)); that is, any “more” is better even if they do not receive the larger prize.

### *Predicting choice switching*

A binary logistic regression analysis with children’s adaptive switching as the predicted variable examined the fit of the model with the predictors of age, feeling sadder in the regret trial only (and the same or happier in the baseline trial), and answering “sadder” to the anticipated regret question. Fully 65% of cases were correctly classified by this model,  $\chi^2(3, N = 211) = 23.90$ ,  $p < .001$ , Nagelkerke’s  $R^2 = .14$ . Feeling sadder in the regret trial only was the only significant predictor of adaptive switching ( $\beta = 1.09$ , Wald = 12.88,  $p < .001$ , odds ratio = 2.99). This was also the case within each condition separately.

<sup>1</sup> The baseline trial controls for the possibility that, on regret trials, children report feeling sadder due to a general tendency to give sadder responses. Either same or happier responses could be viewed as appropriate on this trial because happier responses are likely to reflect relief that the prize in the unchosen box is not better (and happier responses seem to be more likely to be observed in older children; [O’Connor et al., 2012, 2014](#)). In fact, only 2 children reported feeling sadder on the baseline trial, and neither of these children reported feeling sadder on the regret trial. This means that all children who reported feeling sadder on the regret trial reported feeling either the same or happier on the baseline trial.

**Table 1**

Responses to the alternative question in both trials broken down by condition.

Condition	Baseline trial			Regret trial		
	Happier	Sadder	Same	Happier	Sadder	Same
Self ( <i>n</i> = 76)	18	0	58	3	48	25
Dice–Self ( <i>n</i> = 78)	23	1	54	2	42	34
Dice–Other ( <i>n</i> = 75)	21	1	53	6	34	35

**Table 2**

Switching behavior in each trial broken down by condition and whether children felt sadder in the regret trial only (i.e., sadder in the regret trial and either the same or happier in the baseline trial) on Day 1.

Condition	Sadder on Day 1	Baseline trial		Regret trial		Adaptive switching	
		Switch	No switch	Switch	No switch	Yes	No
Self	Yes ( <i>n</i> = 48)	19	29	42	6	27	21
	No ( <i>n</i> = 28)	14	14	20	8	8	20
Dice–Self	Yes ( <i>n</i> = 42)	16	26	38	4	25	17
	No ( <i>n</i> = 36)	20	16	29	7	11	25
Dice–Other	Yes ( <i>n</i> = 34)	9	25	32	2	23	11
	No ( <i>n</i> = 41)	18	23	32	9	17	24

## Discussion

We replicated O'Connor and colleagues' (2014) finding that feeling sadder in a regret task on Day 1 is associated with adaptive choice switching on Day 2. Our main purpose was to examine this association in more detail, looking at (a) whether children's negative emotion in our task on Day 1 is best described as regret and (b) whether anticipated regret, rather than experienced regret, is associated with better decision making. To address the first question, we manipulated children's likely perceptions of their own responsibility for causing the outcome. Although we did not find a significant main effect of our manipulation, the findings were similar to Weisberg and Beck's (2012) findings insofar as children who made a choice (Self condition) were more likely to feel sadder on discovering that they could have won a better prize than those who had the outcome determined by the experimenter's die throw (Dice–Other condition). However, the findings differed from Weisberg and Beck's findings in that in the Dice–Other condition, although only a minority of children reported feeling sadder, they did so significantly more often than chance.

How should we interpret this pattern of findings? If we assume, along with Zeelenberg and colleagues (2000), that responsibility is a necessary condition for regret, we cannot describe the emotion experienced by children in the Dice–Other condition as regret. (The Dice–Self condition is more difficult to interpret because children may erroneously believe that they are responsible for the outcome in that condition; Weisberg & Beck, 2012). One possibility is that children feel something akin to frustration that they have not received the best prize, but (as noted by Rafetseder & Perner, 2012) this frustration could be either a result of thinking about what might have been (i.e., still a counterfactual emotion but not regret) or simply a result of comparing unfavorably what they have (1 token) with what else there is (10 tokens). Our findings do not allow us to distinguish between these possibilities, but the distinction is important because only in the first case is counterfactual thinking involved. Nevertheless, the fact that children were more likely to feel sad in the Self condition than the Dice–Other condition demonstrates that, regardless of how we interpret children's negative emotions in the latter condition, feeling responsible for an outcome affected children's emotions. Thus, it is plausible that at least some of what is measured in the Self condition is regret. As Rafetseder and Perner



(2012) argued, children's emotions in this type of task could be a mixture of regret and frustration, and indeed this may be the best description of what underpins emotion reports in the Self condition.

Regardless of children's level of responsibility for the outcome, feeling sad in the regret trial on Day 1 was associated with adaptive decision making on Day 2, with the strength of this association being similar across conditions. This suggests that, at least in this sort of very simple decision-making task, there may be no special relation between experiencing regret and making a better choice when faced with the same decision again; other negative emotions such as frustration (that may or may not involve counterfactual thought) can play a similar role. The exact mechanism has yet to be characterized, but it is possible that experiencing the negative emotion strengthens the memory for the events or makes it more accessible. Furthermore, our findings strongly suggest that it is the experience of such emotions, rather than their anticipation, that underpins better decision making. Most children were unable to predict that they would feel sadder if an unchosen box contained a better prize despite feeling sadder when faced with such circumstances in reality in our main task, a dissociation that replicates McCormack and Feeney's (2015) findings. Thus, our results are a counterweight to the argument that emotions affect behavior primarily as a result of us simulating and anticipating them in advance of action (see Baumeister et al., 2007). Before children can anticipate a negative emotion such as regret, they can experience the emotion, and that experience, even controlling for any ability to anticipate it, has positive consequences for decision making. Although anticipated regret is likely to increase in importance later on when it starts to emerge (at around 8 years of age; McCormack & Feeney, 2015), our findings suggest that experiencing negative emotions such as regret can directly affect children's decisions.

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